

**REMARKS**

Applicant respectfully requests reconsideration of the present application in view of the foregoing amendments and in view of the reasons that follow.

In the specification, paragraphs starting on page 2, lines 3-6 and lines 29-34 have been replaced.

Claim 14 is requested to be cancelled.

Claims 1-5 and 8-11 are currently being amended.

Claims 15-17 have been added.

This amendment adds, changes and/or deletes claims in this application. A detailed listing of all claims that are, or were, in the application, irrespective of whether the claim(s) remain under examination in the application, is presented, with an appropriate defined status identifier.

After amending the claims as set forth above, claims 1-13 and 15-17 are now pending in this application.

Claims 1-14 were subject to a restriction requirement. The specification has been objected to for some minor informalities. Claims 1-12 and 14 stand rejected as allegedly being unpatentable under 35 U.S.C. § 112, first and second paragraphs. Claims 1-12 and 14 stand rejected under 35 U.S.C. § 103(a) as allegedly being obvious over Ovshinsky et al. (U.S. Patent No. 5,554,456) or Bogdanovic (U.S. Patent No. 5,162,108). Applicants respectfully traverse these rejections for the reasons set forth below.

**The Restriction Requirement Should Be Withdrawn**

The Examiner has maintained the restriction of claim 13 from elected claims 1-12 and 14. Applicants respectfully request that the Examiner reconsider his holding and examine claim 13 together with claims 1-12 and 14.

Contrary to the examiner's assessment, the process claims are restricted to the preparation of the nanocomposite of claim 13 and the properties of the compound recited in this claim are obtained by the process of claims 1 to 12. The Examiner mentioned that the "process as claimed can be used to make other and materially different products such as RE (Mn,Al)<sub>2</sub> alloys." First, the RE (Mn,Al)<sub>2</sub> alloys proposed by the Examiner are not Mg based alloys as required in claim 1. Second, even if the process as presently recited in claim 1 would be applied to prepare RE (Mn,Al)<sub>2</sub> alloys, then the end product would be an amorphous material and not a nanocomposite as described in step (c) of claim 1. Therefore, the process as stated in claims 1 to 12 can only lead to the nanocomposites of claim 13 (these process claims are restricted to the preparation of the nanocomposite of claim 13) and the properties of the nanocomposite recited in claim 13 are only obtained by the process of claims 1 to 12. Withdrawal of the restriction is respectfully requested.

#### **Objection to the Declaration**

The Examiner has required a new declaration since the address of three inventors on page 4 of the declaration had been corrected in the original declaration. While applicants believe that the declaration is proper, applicants request that the PTO's request be held in abeyance as applicants are currently executing a corrected declaration and will forward it to the PTO in due course.

#### **The Objection to the Specification Should Be Withdrawn**

The Examiner objected to the specification since it did not contain a separate description of Figures 4-5, 10-11, 17-18 and 28-29. The specification has been amended herein to provide a separate brief description for each of these figures. Accordingly, the rejection should be withdrawn.

#### **The Rejection Under 35 U.S.C. § 112, First Paragraph Should Be Withdrawn**

Claims 1-12 and 14 stand rejected as allegedly being unpatentable under 35 U.S.C. § 112, first paragraph for the claim term that the "said other element(s) or compound(s) or their

hydride(s) is not  $\text{Mg}_2\text{NiH}_4$ .” For the reasons set forth herein, the rejection is without merit and should be withdrawn.

It is settled that there is nothing inherently ambiguous or uncertain about a negative limitation, so long as the boundaries of the patent protection sought are set forth definitely, albeit negatively. For example, a claim which recited the limitation "said homopolymer being free from the proteins, soaps, resins, and sugars present in natural Hevea rubber" in order to exclude the characteristics of the prior art product, was considered definite because each recited limitation was definite. *In re Wakefield*, 164 USPQ 636, 638, 641 (CCPA 1970). In addition, the negative limitation "incapable of forming a dye with said oxidized developing agent" was held to be definite because the boundaries of the patent protection sought were clear. *In re Barr*, 170 USPQ 330 (CCPA 1971).

If alternative elements are positively recited in the specification, they may be explicitly excluded in the claims. See *In re Johnson*, 194 USPQ 187, 196 (CCPA 1977) ("[the] specification, having described the whole, necessarily described the part remaining."). The proper legal standard for written description analysis is "whether applicants had possession of the claimed invention when the application was originally filed." See *Ex Parte Parks*, 30 USPQ2d 1234, 1236 (Bd. Pat. App. & Inter. 1993). The  $\text{Mg}_2\text{NiH}_4$  compound was positively recited in the specification, see, e.g., page 15, lines 25-28, and, as such, may be explicitly excluded in the claims. Accordingly, Applicants' proviso language has support in the originally filed application and, therefore, withdrawal of this ground for rejection is respectfully requested.

**The Rejection Under 35 U.S.C. § 112, Second Paragraph Should Be Withdrawn**

Claims 1-12 and 14 stand rejected as allegedly being unpatentable under 35 U.S.C. § 112, second paragraph. While not acquiescing to the Examiner's rejections, the claims have been amended herein to clarify the claims. It should be understood that the claims have not been narrowed by the amendments herein. Withdrawal of these rejections is requested.

**Claims 1-12 and 14 Are Patentable Over the Prior Art of Record**

Claims 1-12 and 14 stand rejected under 35 U.S.C. § 103(a) as allegedly being obvious over Ovshinsky or Bogdanovic. To establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. See MPEP §2143.03. As set forth herein, neither Ovshinsky nor Bogdanovic disclose or suggest the instantly claimed invention.

In short, the two cited references teach the use of “gentle” mixing or “mild ball milling” (*i.e.* low energy ball milling) to produce the hydrogen storage materials. In that sense, the references relied upon by the Examiner actually teach away of using high energy ball milling because otherwise, the distinct nature of the components would be destroyed (see *e.g.*, Ovshinsky - column 13, lines 11-15: “these procedures cannot be continued for such a period of time that the separate and distinct nature of the at least two hydrogen storage materials is destroyed”). In contrast, in the present invention the crystal structure of  $\beta$ -MgH<sub>2</sub> is destroyed and transformed into a new metastable  $\gamma$ -MgH<sub>2</sub> phase to produce the active final nanocomposite with activated interfaces. Therefore the person having ordinary skill in the art would not have been motivated to use high energy ball milling viewing either Bogdanovic or Ovshinsky. These references are discussed in more detail below.

Bogdanovic discloses a method for preparing a hydrogen storage material comprising an active or doped Mg, which material is not nanocrystalline. This method according to Bogdanovic basically consists of contacting a finely divided powder of magnesium hydride or metallic magnesium with a finely divided powder of a transition metal which acts as a catalyst. Mixing is preferably carried out in an aqueous solution (see the abstract).

According to Bogdanovic, various methods are used for doping the powder of magnesium hydride (see column 3, line 29 to column 4, line 33):

- (a) mixing in a solution magnesium hydride with a transition metal and subsequently subjecting the resulting product to thermal decomposition (fine particles of the transition metal are then deposited onto the surface of MgH<sub>2</sub> particles):
- (b) mixing a solution of magnesium hydride with a complex of a transition metal and subsequently introducing hydrogen to the solution (the hydrogen reacts with the

complex and decomposes it, whereby the metal of transition is precipitated onto the surface of the  $\text{MgH}_2$  particles);

(c) mixing a solution of magnesium hydride with an organic compound containing a transition metal;

(d) doping by reduction of a transition metal complex with magnesium hydride so as to form a salt of magnesium; and

(e) doping by mechanical mixing in a dry form or in solution a finely divided powder of Mg or  $\text{MgH}_2$  with the powder of the transition metal.

According to Bogdanovic, the mixing is made as low energy as is demonstrated in Example 11 which shows the use of a glass ball mill. As such, Bogdanovic does not render the claimed method obvious. In the present invention, it is important to use  $\text{MgH}_2$  instead of Mg (see page 8, lines 14 to 21 and page 14, lines 1 to 13 of the specification); and the claimed method recites the use of "high intensive mechanical grinding" to obtain an alloy in a nanocrystalline state. While not wishing to be bound by theory, it is believed that the "high intensive mechanical grinding" transforms the crystalline structure of  $\text{MgH}_2$  into a metastable phase (transformation of its phase  $\beta$  into its phase  $\gamma$ ) while making defects in them to create particular interfaces between the  $\text{MgH}_2$  and the second component by reaction of a solid state.

It is worth noting that the result obtained with the compounds according to the invention and those disclosed in Bogdanovic are not comparable at all. The materials of Bogdanovic require a high temperature for operation "the magnesium or magnesium hydride powder so doped is also extremely active in absorbing and desorbing hydrogen, *e.g.* picking up or giving off 6.5 to 7.65% its weight of hydrogen at about 250°C-400°C" (see column 4, lines 28 to 32). At this temperature (for example 267°C in Table I of Bogdanovic), the typical time for hydrogenation is of a few hours. In comparison, the compounds according to the present invention absorb hydrogen in high quantity at the room temperature in a few minutes while at temperature of about 267°C, the absorption is made in a few seconds instead of a few hours (see figure 10 of the present application). As such, Bogdanovic does not disclose or suggest the method set forth in claim 1. Since claims 2-12 and 14-17 depend from claim 1, for at least this reason these claims are patentable over Bogdanovic.

Ovshinsky discloses a heterogeneous composite which is not a nanocomposite. See, *e.g.* the specific reference is made to a “microlevel” difference in claim 2. This heterogeneous composite comprises at least two separate and distinct hydrogen storage alloys blended together, for use in the electrochemical field. Each component of the composite can be prepared by a multitude of different methods including rapid solidification (column 12, lines 36 to 38) laser ablation (see column 13, lines 23 and 24) or conventional melt-hydride grinding process (see column 12, lines 32 to 35). The latter method is well known. It consists in first preparing a ingot of alloys (for example Mg-Ni), then melting and subsequently hydrogenating this ingot to make it fragile and finally processing it and breaking it to convert it into a powder. The resulting powder is a fine polycrystalline powder of conventional size, not a nanocrystalline powder like those obtained and prepared by the “intensive mechanical grinding” of the claimed invention.

Ovshinsky also discloses a method for preparing such a composite where the two basic components are mechanically mixed (see column 6, lines 3 to 6). In column 12, line 65 to Col. 13, line 15, Ovshinsky discloses that:

Once the at least two separate and distinct hydrogen storage alloys have been formulated, they may be combined using any fabrication method that effectively permits the retention of their separate and distinct nature. For example, the at least two separate and distinct hydrogen storage alloys may be combined using mechanical alloying... Mechanical blending or alloying techniques such as ball milling or impact block mixing must be done for a sufficient time to provide electrical connectivity between individual particles. However, these procedures cannot be continued for such a period of time that the separate and distinct nature of the at least two hydrogen storage alloys is destroyed. . . .

Thus, Ovshinsky discloses only a method wherein two components are mixed but does not disclose or suggest that these two components should be mixed under “high intensive mechanical grinding”, since such would affect their nature (see claim 17 in column 18, line 27). This is the contrary to the claimed method. In accordance with the present invention, the two components are subjected to an “intensive mechanical grinding” in order to modify their nature. The phase  $\beta$  of  $\text{MgH}_2$  is converted into a phase  $\gamma$  and the second

component is hydrogenated (for example, V is converted into  $VH_{0.81}$  - see page 14, lines 2 to 5 of the specification-). Moreover, the "intensive mechanical grinding" transforms the polycrystalline structure of the components into a nanocrystalline structure in addition of producing activated interfaces between the components, thereby forming a very efficient nanocomposite material. As such Ovshinsky does not disclose or suggest the method set forth in claim 1. Since claims 2-12 and 14-17 depend from claim 1, for at least this reason these claims are patentable over Ovshinsky.

Applicant believes that the present application is now in condition for allowance. Favorable reconsideration of the application as amended is respectfully requested.

The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by a check being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741. If any extensions of time are needed for timely acceptance of papers submitted herewith, Applicant hereby petitions for such extension under 37 C.F.R. §1.136 and authorizes payment of any such extensions fees to Deposit Account No. 19-0741.

Respectfully submitted,

Date 15 December 2003

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